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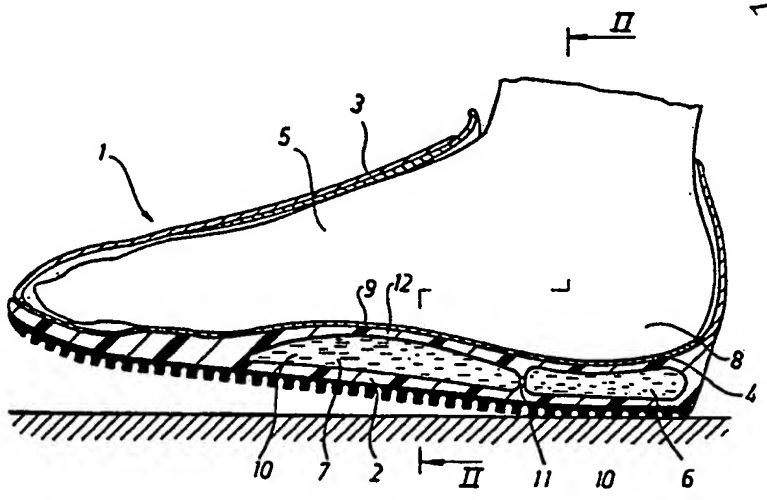

(57) Abstract

In a shoe sole (2) comprising a first chamber (6) and a second chamber (7), which chambers are completely or partially filled with a fluid (10), and a channel (11) interconnecting said chambers (6, 7), by means of which channel the fluid (10) upon compression of one of the chambers (6 or 7) may be transferred to the other one of said chambers to expand said other chamber, the first chamber (6) is positioned so as to extend essentially only underneath the heel portion (8) of the foot (5) whereas the second chamber (7) is positioned so as to extend essentially only underneath the longitudinal arch (9) of the foot (5). Upon expansion of the second chamber (7) due to the compression of the first chamber (6) when affected by the heel portion (8), said second chamber forms a dynamic pronation support underneath the longitudinal arch (9). When this arch bears a weight thereon, it causes the second chamber (7) to be compressed.

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SHOE SOLE CONSTRUCTION

The present invention generally concerns a shoe sole having a dynamically shock-absorbing structure, but above all a shoe sole providing a dynamic pronation support. The shoe sole is particularly suitable for sport shoes and may be used for instance for running on hard surfaces. It may also be used in e.g. walking boots, working shoes, in principle in all types of footgear. It may also be designed as a separate insole to be placed inside the shoe it is designed for.

In walking and running, the foot has to bear considerable weight corresponding to several times the body weight, each time it is set down into contact with the ground or the surface underneath. The cushion of fat found for instance in the heel dampens the impact upon heel strikes, that is the phase of the walking cycle when the heel is set down into contact with the surface underfoot. At the midstance stage of the walking cycle, when the whole foot is in contact with the surface, and at the heel elevation stage, when the heel portion is lifted, the main weight is on the longitudinal arch of the foot (the arch extending lengthwise on the inner side of the foot), resulting in deformation of this arch which plays an important part of the energy absorption.

During walking and running the feet pronate, i.e. the outwards margin of the foot is turned outwards-upwards as the foot is set down on the ground or the support. An increase of the pronation results in an increase of the weight on the longitudinal arch of the foot and consequently a higher risk of overstraining, which in turn may be the cause of permanent deformation of the arch.

Congenital anatomic conditions, such as an increased pronation or other weaknesses in the foot, cause degradation or weakening of the various functions of the foot which may give rise to insufficiency symptoms originating from the longitudinal arch. The problems caused by

weakened longitudinal arches may often be remedied by the use of suitable arch supports. Also originally normal longitudinal arches may, when exposed repeatedly to heavy loads from walking or running on very hard surfaces, may lose their vaulted shape and consequently their weight-distributing capacity, which could also produce insufficiency symptoms.

Problems of this kind are common and are caused for instance by the use of unsuitable or bad-fitting shoes, or e.g. by activities carried out on hard surfaces, such as ashpalt and concrete. Preventive as well as therapeutic measures to avoid such insufficiency conditions therefore are most important. Malfunctioning of the feet and unsuitable or badly constructed shoes may also cause injuries and lead to insufficiency conditions, particularly in the lower extremities, such as the feet, the ankle joints, the lower leg, the knee joints, the hip region and the back.

Sport activities expose the body to considerable stress and strain. Particularly during sports activities such as running, jumping, and the like, large parts of the skeleton must bear considerable weight, a condition which is aggravated for instance by excess pronation, and which may lead to injuries on the lower extremities and in the back. Such injuries may occur as a result of long-standing and repeated weight bearing, as is the case with for instance long-distance runners, or may be caused by isolated instances of heavy but unsuitable exposures to weight bearing, such as may be experienced e.g. in triple jumping.

Shoes for sport uses therefore should have a sole which is able to absorb and cushion as far as possible the shocks and the load produced as the foot is set down into contact with the ground. However, the shoe sole must not be too thick, as this would make the shoe too heavy and thus impair the achievable results of the contestant.

The purpose of the present invention thus is to provide a shoe sole of a construction that is capable of providing satisfactory shock absorption while at the same time giving the longitudinal arch of the foot a dynamic pronation support.

To achieve this purpose, the shoe sole in accordance with the invention is formed with a first chamber and a second chamber arranged in the sole and completely or partially filled with a fluid, and with a channel interconnecting said chambers, said channel arranged, upon compression of one of the chambers, e.g. the first chamber, to transmit fluid from said first compressed chamber to the second one of said chambers for expansion of said second chamber, or vice versa, said first chamber being positioned essentially only underneath the heel portion of the foot. The characteristic features of the invention are that the second chamber is positioned essentially only underneath the longitudinal arch of the foot and in that due to the compression of the first chamber when the latter is activated by the heel portion, said second chamber fills with fluid and expands, lifting the longitudinal arch immediately prior to said arch absorbing the load and thereafter being deformed. In this manner the arch of the foot receives a dynamic support during the deformation which is gradually dampened.

By means of a shoe sole constructed in this manner excellent shock absorption is achieved as the heel portion is set down on the support while at the same time the person wearing the shoe enjoys a dynamic pronation support at midstance, i.e. when the entire foot is in contact with the ground. A shoe sole of this construction considerably reduces the risks for injuries on and insufficiency conditions arising from above all the longitudinal arch of the foot and the lower extremities while at the same time it facilitates sports activities, such as running, jumping and similar sports.

The invention will be described in closer detail in the following with reference to the accompanying drawings illustrating an embodiment thereof which is preferred at the moment, and wherein

Fig. 1 schematically in a longitudinal section view illustrates a shoe fitted with a sole in accordance with the invention in the heel-strike phase of walking or running, i.e. when the heel portion is set down into contact with the ground.

Fig. 2 is a cross-sectional view along line II-II of Fig. 1.

Fig. 3 is a view similar to Fig. 1 but illustrates the heel elevation phase of the cycle, i.e. when the rest of the foot is set down into contact with the ground but the heel portion is lifted.

Fig. 4 illustrates schematically in a perspective view obliquely from above the shoe sole in accordance with Figs. 1 and 3, showing in closer detail the position of the chambers formed in the sole.

The shoe sole illustrated in the drawing figures indicated generally by reference 1, comprises a sole 2 to be described in closer detail in the following, uppers 3 and an insole 4. The shoe is shown worn on a foot 5.

As appears from the drawing figures, the sole is formed with a first chamber 6 and a second chamber 7, the first one of which, 6, being positioned essentially only underneath the heel portion 8 of the foot 5 whereas the second chamber 7 is positioned essentially only underneath the longitudinal arch 9 of the foot 5.

The first and the second chambers, 6 and 7, respectively, are completely or partially filled with a suitable fluid 10, such as a gas och a more or less viscous liquid. The chambers 6 and 7 are interconnected by means of an interconnection channel 11 which is arranged in the interior of the sole 2 and which may be formed by two or several branch channels.

Via the interconnection channel 11 the fluid 10 may be transferred from one channel to the other, i.e. upon compression of chamber 6 it is transferred to chamber 7 to expand the latter, and reversely. Upon expansion of the second chamber 7 due to the compression of the first chamber 6 as the latter is affected by the heel portion 8 of the foot 5, the second chamber 7 acts as a dynamic pronation support underneath the longitudinal foot arch 9, whereby, when the latter is exposed to load as a result of the foot hitting the ground, said second chamber 7 will be compressed followed by expansion of the first chamber 6 via the interconnection channel 11.

As appears particularly from Figs. 1, 2 and 4, the second chamber 7, in its expanded condition, will impart to the portion 12 of the sole 2 that is contiguous with the longitudinal arch 9 a configuration conforming to the natural shape of the longitudinal arch 9 of the foot in the non weight-bearing condition of the arch.

In order to produce a controlled and/or predetermined throttling of the flow of the fluid 10 between the chambers 6 and 7 via the interconnection channel 11, the latter may be formed in one or several of the branches thereof with a throttling means, not shown, e.g. in the shape of a constriction of the channel and/or an adjustable throttling valve.

For the purpose of supplying or removing fluid 10 and thus of adapting the dynamic pronation support at will and according to need an external connection fitting, not shown, may be provided for at least one of the chambers 6, 7 and/or for the interconnection channel 11. The external fitting could comprise a non-return valve or similar means in the edge portion of the sole 2, said non-return valve being connected to the associated one of chambers 6, 7 and/or to theinterconnection channel 11 via a connecting passageway.

Like the interconnection channel 11 which as mentioned previously may be formed from two or several part or branch channels also the first and/or the second chambers 6 and 7, respectively, could of course be divided into two or several part chambers to vary the qualities of the shoe 1 or of the sole 2. For instance, the sole 2 may thus be made more or less resilient and its shock-absorbing and supporting effect be made larger or smaller.

The invention should of course not be regarded as limited to the embodiment illustrated in the drawings and referred to in the aforegoing but may be modified in a variety of ways within the scope of the appended claims.

CLAIMS

1. A shoe sole comprising a first chamber and a second chamber (6 and 7, respectively), said chambers arranged in said sole and completely or partially filled with a fluid (10), and a channel (11) interconnecting said chambers (6, 7), through which interconnecting channel (11), upon compression of said first chamber (6), fluid (10) may be transmitted from said first chamber (6) to the second one (7) of said chambers for expansion of said second chamber (7), or reversely, said first chamber (6) being positioned essentially only underneath the heel portion (8) of the foot (5), c h a r a c t e r i z e d in that the second chamber (7) is positioned essentially only underneath the longitudinal arch (9) of the foot (5) and in that due to the compression of the first chamber (6) when the latter is affected by the heel portion (8), said second chamber (7) fills with fluid (10) and expands so as to lift the longitudinal arch (9) immediately before said arch (9) is about to absorb the load which arch is then deformed, whereby said longitudinal arch (9) receives a dynamic support during the deformation which is gradually dampened.

2. A shoe sole as claimed in claim 1, c h a r a c - t e r i z e d in that in its expanded condition the second chamber (7) imparts to the portion (12) of the sole (2) that is contiguous with the longitudinal arch (9) a configuration conforming to the natural shape of the longitudinal arch (9) of the foot in the non weight-bearing condition of said arch.

3. A shoe sole as claimed in claim 1 or 2, c h a r a c t e r i z e d in that the interconnecting channel (11) comprises a throttling means for controlled and/or predetermined throttling of the flow of the fluid (10) between the chambers (6, 7).

4. A shoe sole as claimed in any one of the preceding claims, c h a r a c t e r i z e d in that at least one of the chambers (6, 7) or the interconnecting

channel (11) is provided with an external connection fitting for supply or removal of fluid (10) and thus adaption of the dynamic pronation suppport according at will and according to wish.

5. A shoe sole as claimed in claim 4, c h a r a c t e r i z e d in that said external connection fitting is formed with a non-return valve in the edge portion of the sole (2), said non-return valve connected to the associated one of the chambers (6, 7) and/or to the interconnecting channel (11) via a connecting passageway.

6. A shoe sole as claimed in any one of the preceding claims, c h a r a c t e r i z e d in that the first and/or the second chamber (6, 7) is/are divided into two or several part chambers.

7. A shoe sole as claimed in any one of the preceding claims, c h a r a c t e r i z e d in that the interconnection channel (11) is arranged in the interior of the sole (2) and is formed by two or several part channels.

Fig.1

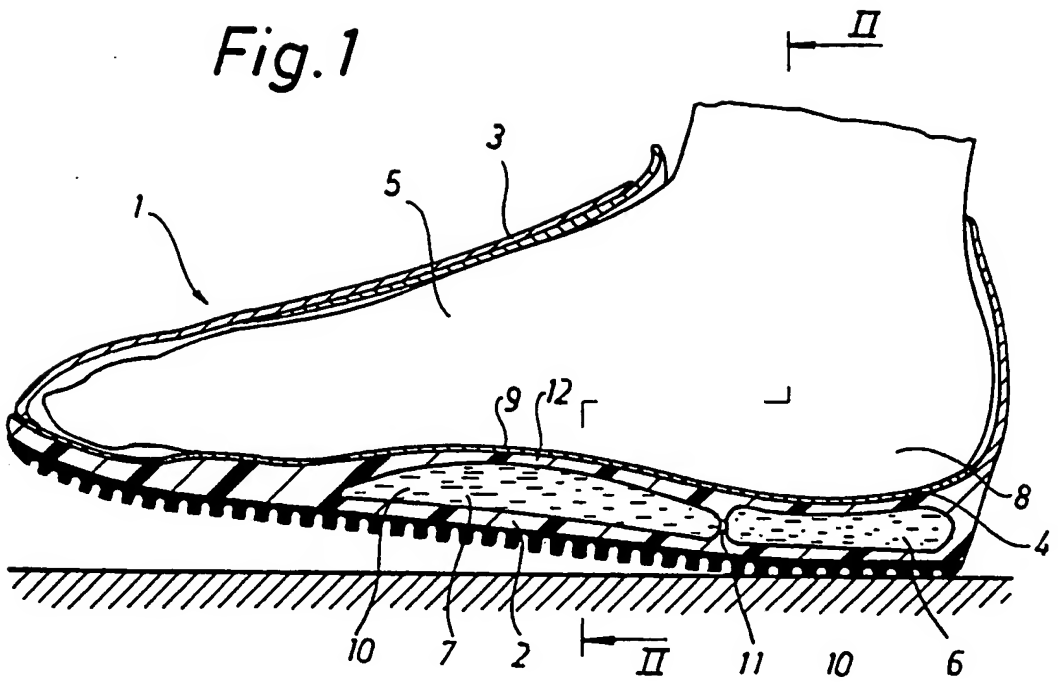


Fig. 3

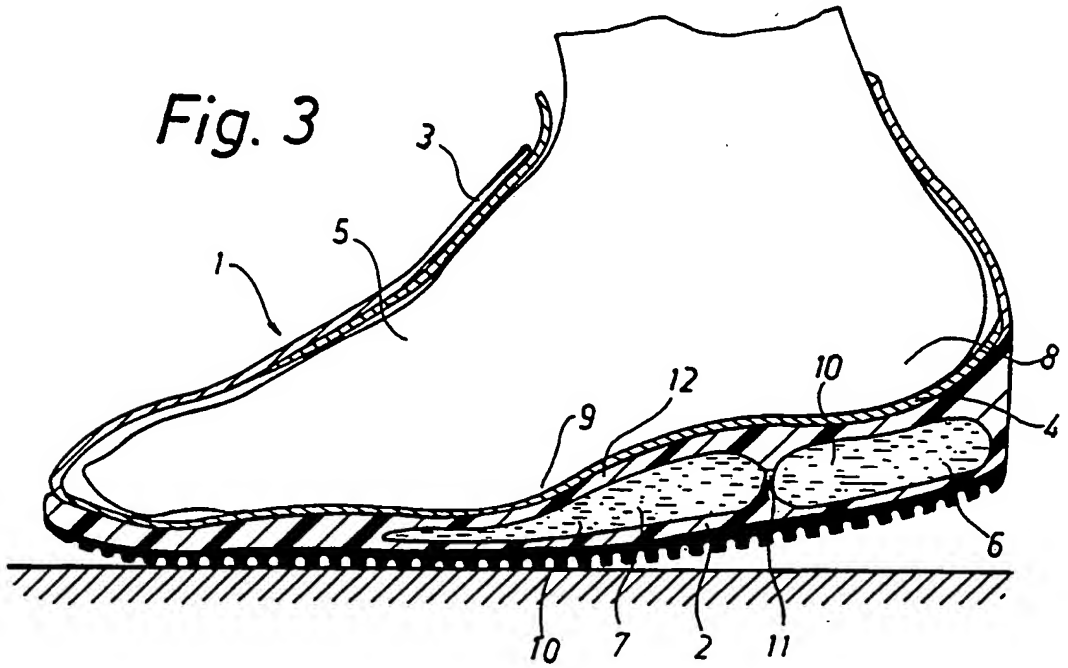


Fig. 2

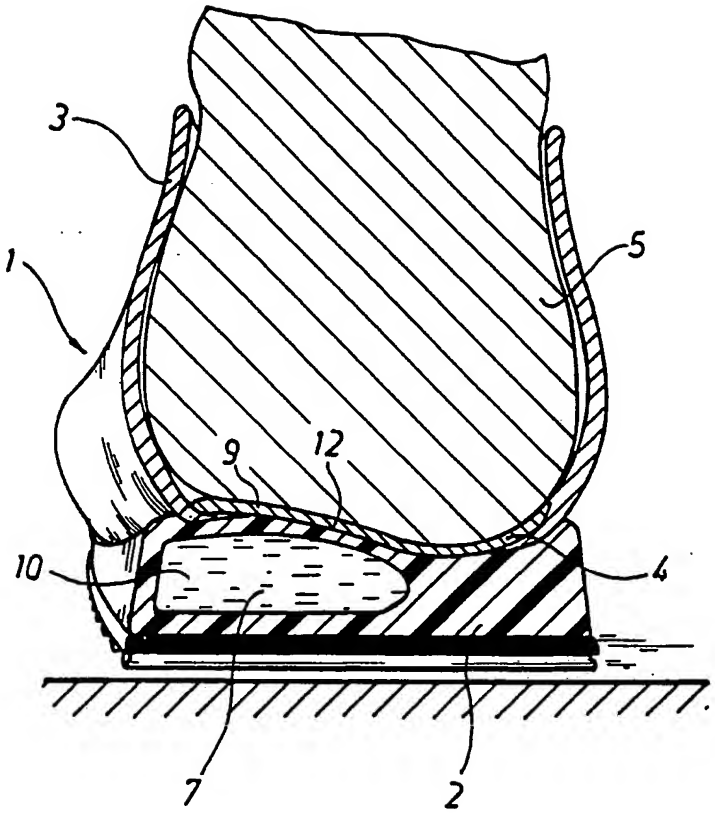
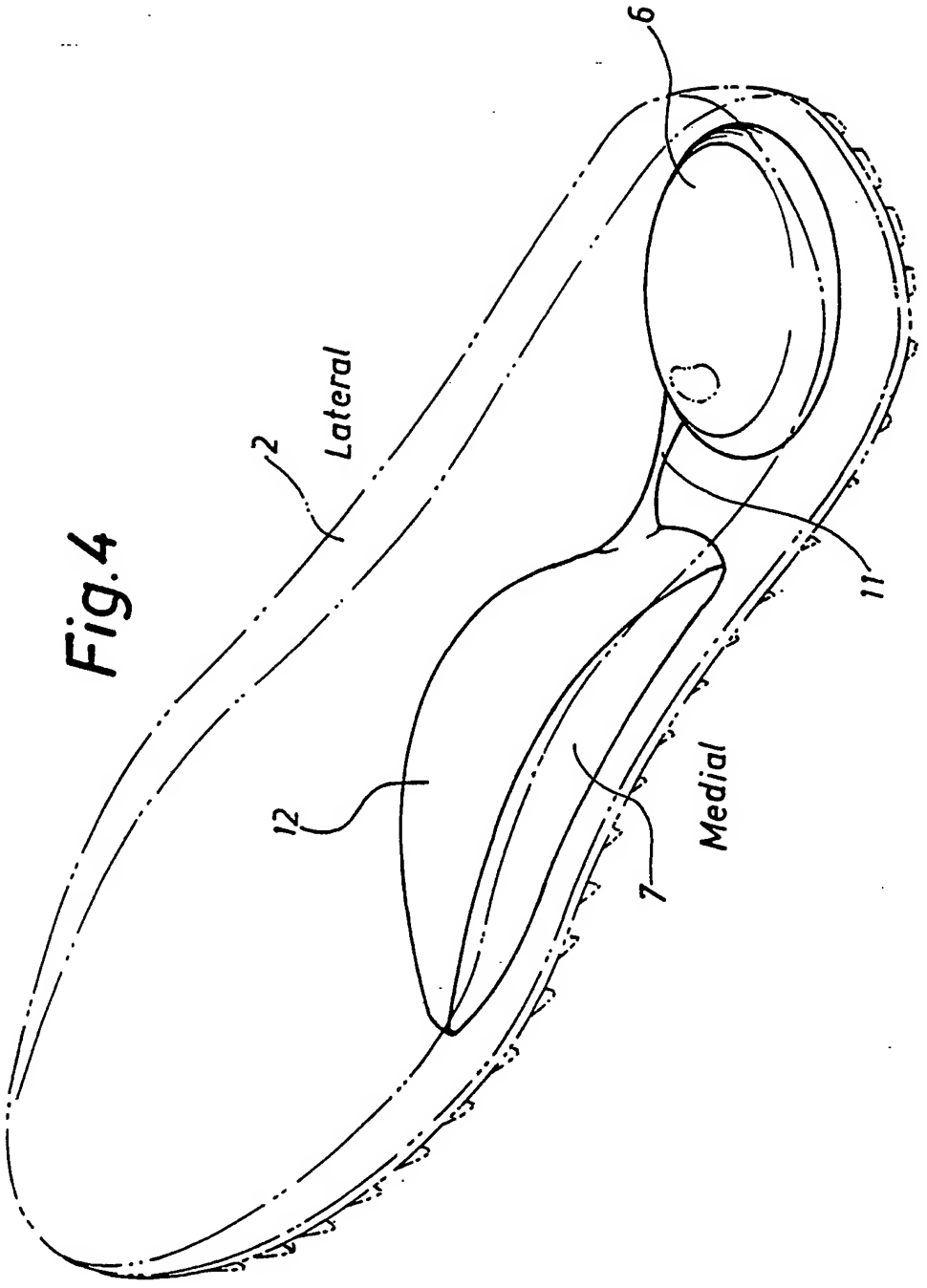


Fig.4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00239

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A43B 13/18 // A61F 5/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A43B, A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4358902 (COLE ET AL), 16 November 1982 (16.11.82) --	1-7
Y	US, A, 4446634 (JOHNSON ET AL), 8 May 1984 (08.05.84) --	1-7
Y	US, A, 4458430 (PETERSON), 10 July 1984 (10.07.84) --	1-7
Y	US, A, 4577417 (COLE), 25 March 1986 (25.03.86) --	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 1544547 (G.S. BARKER), 7 July 1925 (07.07.25) --	1-7
Y	US, A, 1605985 (K.J. RASMUSSEN), 9 November 1926 (09.11.26) --	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/05/93

International application No.
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		JP-A- 56139702	31/10/81
US-A- 4446634	08/05/84	NONE	
US-A- 4458430	10/07/84	DE-A- 3277831	28/01/88
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		SE-T3- 0062622	
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		SE-T3- 0160880	
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US-A- 1605985	09/11/26	NONE	